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Improving the Quality of Rice Bran by Utilization of Lignocellulosic Enzymes for Broiler Feed

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ABSTRACT

Utilization constraints rice bran as animal feed that contains mostly along rough composed of cellulose , hemicellulose and lignin is high. The cell walls of rice bran have lignified more complex forms a bond with the lignin. This study used a completely randomized design with five treatments and six replications, factors lignocellulosic enzymes dose tested their effects on the nutritional content of rice bran : P0 = rice bran (control): P1 = rice bran + 2% lignocellulosic enzymes; P2 = rice bran + 4% lignocellulosic enzymes; P3 = rice bran + 6% lignocellulosic enzymes; P4 = rice bran + 8% lignocellulosic enzymes. The conclusion of this study was a dose of 4 % lignocellulosic enzymes could decrease fraction of crude fiber, cellulose and increase crude protein so it can be used as raw material for broiler feed.
KEYWORDS: cellulose, lignocellulosic enzymes, rice bran, broiler

INTRODUCTION

Rice bran is a byproduct of the process of milling the rice plants are widely used as raw material for animal feed . The primary cell wall of plants have a complex structure , namely : 1. The polysaccharide composed of cellulose (a polymer ß - 1,4 - glucose) , hemicellulose (xylose, galactose or mannose primer), and pectin which include polymethyl-galacturonic acid and polygalacturonic acid, 2 . Lignin (phenylpropane polymer) , and 3. Glycoprotein. Substances hydrolysis process is done by enzymatic biotechnology [1]

The constraints utilization of rice bran as animal feed that contains most of the high crude fiber composed of cellulose, hemicellulose and lignin. Cellulose and hemicellulose are coarse fiber which is the main constituent of plant cell walls, is one of the organic material contained in large quantities in nature and is a source of energy (*renewable energy sources*) potential for livestock. Limitations of the use of cellulose and hemicellulose of rice bran in broiler, the broiler do not have the lignocellulosic enzymes producing by digest tract. This is different to ruminants (cattle, sheep, goats), rumen microbes producing lignocellulosic enzymes can decide the configuration of the bond ß-1-4-glicosidic to help the degradation of cellulose and hemicellulose [2]. Results of the proximate analysis of rice bran nutrient content based on dry matter: crude protein 7.45%; crude fiber 37.39%, 21.39% ash, nitrogen free extract (NFE) 27.13% and metabolic energy (ME) 1813.82 kcal /kg, cellulose 23.21%.

In order to solve rice bran nutrition quality problem, several innovations on enzymatic technology should be done. One of them is through feed manipulation, by adding lignocellulosic enzymes produced by lignocellulosic bacteria (*Bacillus pumilus* and *Actinobacillus sp*) which are able to degrade the bonds of cellulose, hemicellulose, and lignin during agro-industry waste degradation process for livestock feed. Livestock feed production process which applies biological approach is much safer than production process using chemical ingredients that may pollute the environment. The utilization of cellulosic and hemicellulosic enzymes may improve the nutrition value of rice bran. Cellulosic enzyme consists of three components, namely C1 (3-1,4-glucan cellobiohydrolase or exo-3-1,4-glucanase), Cc (endo-3-1,4-glucanase), and

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cellobiase (3-glucocidase). Meanwhile, hemicellulosic enzymes consist of endo-3-1,4-xylanase, 3-xylosidase, a-L-arabinofuranosidase, a-D-glucuronidase, and acetyl-xylan-esterase[3] There was only a little information regarding lignocelluloses as enzymatic process supplementation on agricultural waste (i.e. rice bran) used as poultry feed. Cellulose biodegradation utilizing cellulosic enzyme produced by microbes was vital in processing agricultural waste (rice bran) into broiler feed [3,4]. Supplementing cellulosic enzymes into poultry feed can improve feed efficiency and poultry performance by improving in-vitro[5,6], in–site[7,8], and in-vivo [9] fiber digestibility.

Cellulose is the part of plant cell walls, and also the largest in the plant . Plants normally contains cellulose as much as 40-50 %, the other constituent components are lignin (20-30%) and hemicellulose (10-30%). When plants die naturally cellulose, hemicellulose, and lignin to be degraded by soil microorganisms [10]. Hemicellulose is a unitary construct fiber composition. Hemicellulose has an important role because it is hydrophilic so it can function as an adhesive between the cellulose fibers that support the physical strength. Hemicellulose loss will cause a hole between the fibrils and the lack of bonding between the fibers.

This study was intended to determine to determine the use of enzymes lignoselulase the enzymatic process on a byproduct of agricultural waste (rice bran) to improve the quality of broiler feed.

MATERIALS AND METHODS

Rice bran are weighed each weighing 500 grams. All the ingredients were fermented for one week with a doses of lignocellulosic enzymes 0, 2, 4, 6 and 8%. This study used a completely randomized design with five treatments and six replications, all the materials in this study were made uniform. Factors lignocellulosic enzymes dose tested their effects on the nutritional content of rice bran : P0 = rice bran (control): P1 = rice bran + 2% lignocellulosic enzymes; P2 = rice bran + 4% lignocellulosic enzymes; P3 = rice bran + 6% lignocellulosic enzymes; P4 = rice bran + 8% lignocellulosic enzymes. All materials were fermented for 5 days. Fermented rice bran performed for each treatment using the appropriate dose of lignocellulosic enzymes treatment. Rice bran put in a plastic bag labeled experimental and facultative *anaerobic* fermentation of rice bran is seven days. After an incubation period of seven days is complete, the sample was opened and analyzed content of nutrients. Laboratory analysis was performed to measure the dry matter (DM), organic matter (BO), crude protein (CP), crude fiber (SK) using the methods of AOAC [11], and neutral detergent fiber (cellulose) using the method of [12]. The results of the study were analyzed using analysis of variance, followed by Duncan 's Multiple Range Test [13] .

RESULTS AND DISCUSSION

Nutrient content of fermented rice bran using lignocellulosic enzymes as biocatalysts presented in Table 1.

Table 1. Average Nutrition Rice Bran by Addition of Lignocellulosic Enzymes as Biocatalysts

Nutrition (%) DM	PO	P1	P2	P3	P4
Crude protein (CP)	8.07^{a}	9.89^{b}	12.20^{c}	12.51^{c}	12.14^{c}
Crude fiber (CF)	24.88^{a}	21.58^{b}	21.04^{c}	18.66^{c}	18.69^{c}
Ash	14.12^{c}	9.86^{b}	8.21^{a}	10.77^{b}	10.51^{b}
Ekstract Eter (EE)	7.72^{a}	7.80^{a}	7.08^{ab}	6.59^{b}	7.15^{ab}
Organic matter (OM)	83.38^{a}	85.97^{b}	87.53^{bc}	88.14^{bc}	88.74^{bc}
Cellulose	**26.38c**	**23.07^{b}**	**20.45^{a}**	**20.83^{a}**	**19.37^{a}**

Based on the nutritional content of treatment P0 , P1 , P2 , P3 and P4 in Table 1. obtained the nutritional value varies mainly crude protein , crude fiber , organic matter and cellulose. Treatment P2 , P3 and P4 have the highest content of CP and CF, but cellulose lower than P1 and PO . The increasing content of CP in P2 and P3 due to the addition of enzymes lignoselulase function as biocatalysts is a protein

composed of amino acids bound to each other by peptide bonds forming peptide chain . Enzymes can be either pure protein or combination of proteins with other chemical groups . Protein enzymes are molecules that very large molecular weight ranging between 10000-1000000 Da [9] . The addition of enzymes will increase the amount of amino acids so that the availability of nitrogen that is fixed to the rice bran network increases.

Crude fiber and cellulose of rice bran content decreased with the addition of lignocellulosic enzymes on P2 , P3 and P4 . This is due to the activity of the content complex catalyzing complete feed substrate which hydrolyze non- starch polysaccharides in bonds β-1,4-glycosidic [14]. Lignocellulosic enzymes activity during curing will hydrolyze cellulose and hemicellulose components in rice bran which is large enough carbohydrate molecules into molecules - molecules disaccharide sugar or monosaccharide . Cellulose and hemicellulose has a complex structure which is the main component of plant cell walls . Lignohemiselulosa total hydrolysis of lignocellulose and requires synergy several different enzymes to hydrolyze the polymer is complete into simple sugars constituent [15].

A decrease in crude fiber and cellulose as well as an increase in crude protein is the result of hydrolysis by lignocellulosic enzymes. Lignocellulosic enzymes is added to help in the process of degradation of cellulose and hemicellulose, which is part of the constituent raw fiber into a monomer-monomer. In addition to the low value of crude fiber, feed raw materials should ideally also contain other nutrients that also support. One of them is also important in sustaining the productivity of livestock is cattle protein. The addition of lignocellulosic enzymes and bacteria lignocellulolytic in the process of hydrolysis, it gives additional value to the crude protein substrate agro-industry waste. Enzymes are biological catalysts that form of the protein. The content of protein in the lignocellulosic enzymes and bacterial growth were added this slightly increases the crude protein value, so that the nutrient content in the feed fibrous substrate (rice bran) was also increased.

Endo1,4-β-glucanase cut the cellulose chains of cellulose molecules produce shorter, ekso1,4-β-glucanase cut ends of cellulose chains produce cellobiose molecules, whereas β-glucosidase cut cellobiose molecules into two molecules of glucose. Eksoglucanase enzymes attack the amorphous cellulose fibers, paving the way for the action of the enzyme endoglucanase. Furthermore, these enzymes cooperate mutually liberating cellobiose fibers of cellulose fibers. Enzymes endoglucanase and selobiohidrolase not able to break down cellobiose necessitating another enzyme is β-glucosidase which outlines cellobiose to glucose. Decline in crude fiber content of rice bran is also due to the looseness of bonding lignocellulose and lignohemicellulose due to the addition of the lignocellulosic enzymes capable of degrading cellulose enzymatically. There are three main groups of enzymes that make the enzyme cellulase endo ß glukonase 1.4, 1.4 exo glukonase ß and ß-glucosidase [15]. Results of this study demonstrate that the use of lignocellulosic enzymes as the fermentation of rice bran contributes to the decline in crude fiber content of rice bran and increased crude protein content in P2, P3, and P4.

CONCLUSION

Addition of lignocellulolytic enzymes into rice bran improved significantly the quality of rice bran. An optimal level was achieved by addition 4% lignocellulolytic enzymes could decrease fraction of crude fiber, cellulose and increase crude protein so it can be used as raw material for broiler feed.

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REFERENCES

1. Juhasz, T., Z. Szengyel, K. Reczey, M Siika-Aho, L. Viikari. 2005. *Characterization of cellulases and hemicellulases produced by Trichoderma reesei on various carbon sources*. Process Biochemistry 40 (2005 3519-3525 Elsevier Ltd.
2. Muthukrishnan, R. 2007. *Characterisation Of Cellulase From Organisms Isolated From Rumen Fluid*. http://www.pharmainfo.net/reviews/characterisation-cellulase-organisms-isolated-rumen-fluid
3. KS Azad; S Rahimi; KMA Torshizi. Iranian Journal of Veterinary Research., 2009, Vol. 10 (2),27.
4. Murad HH, Hanfy MA, Kholif AM, Gawad MHA and Murad HA. *J. Biol. Chem. Environ. Sci*., 2009, 4: 791- 809.
5. Gado H.M., Salem AZM, Camacho LM, Elghandour MMY, Salazar MC, *Animal Nutrition and Feed Technology ,* 2013, 13: 569-574.
6. Rodrigues MAM, Pinto P, Bezerra RMF, Dias AA and Guedes CVM. *Anim. Feed Sci. Technol.,* 2008, 141: 326- 338.
7. Tricarico JM, Johnston JD, Dawson KA, Hanson KC, McLeod KR and Harmon DL. *Anim. Sci*., 2005, 81: 365- 374.
8. Krueger NA, Adesogan AT, Staples CR, Krueger WK, Kim SC, Littell RC and Sollenberger LE. *J. Anim. Sci.,* 2008,. 86:882–889.
9. Gado HM, Salem AZM, Odongo NE, Borhami BE, *Animal Feed Science and Technology* 2011, 165 (1), 131- 136.
10. Pelczar, M.J. and Chan, E.C.S. 1986. *Dasar-dasar Mikrobiologi*. Jil;id I. UI-Press, Jakarta.
11. AOAC.2005. Official Methode of Analysis of The Association of Official Analytical Chemist. Association of Official Analytical Chemist. Arlington.
12. Goering, H.K. and P.J. Van Soest. 1970. *Forage Fiber Analysis, Agriculture* Hand Book No. 379, Agriculture research Service, USDA, Washington DC
13. Steel, R.G.D. and J.H. Torrie. 1980. Principles and Procedure of Statistics. McGraw-Hill Book Co. Inc. New York.
14. Kregel, U. and B.M. Djikstra. 1996. The dimensional structure of endo 1,4 xylanase from Aspergillus niger : molecular basis for its low pH optimum. *J. Mol. Biol* 263 : 70-78.
15. Subramaniyan, S and P. Prema. 2002. Biotechnology of Microbial Xylanases : Enzymology, Molecular Biology and application. *Critical Rev Biotecnol* 22: 33-64.